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(54) **ELEVATOR SYSTEM BELT HAVING CONNECTING DEVICES ATTACHED THERETO**

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CPC ***B66B 7/062*** (2013.01); ***B66B 7/085*** (2013.01); ***H02G 11/006*** (2013.01); *Y10T 29/49194* (2015.01)

(58) **Field of Classification Search**
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USPC 187/251, 254, 411, 255, 54, 266, 391, 187/413
See application file for complete search history.

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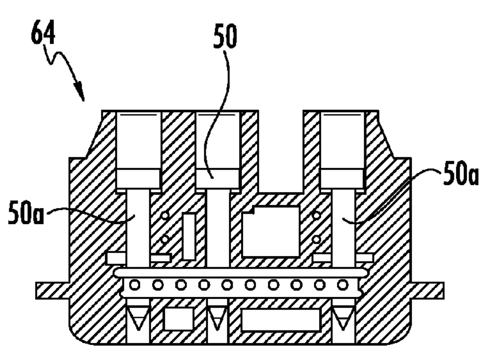
(57) **ABSTRACT**

An assembly comprising (a) a belt, which includes a plurality of wire cords extending lengthwise of the belt with spaces therebetween, and includes a coating of the cords extending into the spaces between the cords, said belt being configured for use in an elevator system as a suspension belt for a car and a counterweight, or being configured for use in an elevator system as a drive belt for a car or for a counterweight, or being configured for use in an elevator system as a combined suspension and drive belt for a car and a counterweight; (b) a first connecting device including a first number of cord contacting elements providing electrical connections contacting element-to-cord; and (c) a second connecting device, including a second number of cord contacting elements providing electrical connections contacting element-to-cord, and including at least two conductive elements, each being electrically connected to a respective one of the cord contacting elements, the conductive elements being provided for making electrical connections to a belt monitoring unit which monitors the proper condition of the cords on the basis of electrical signals passed through the cords; (d) wherein at least one of the first and second connecting devices includes at least one bridge type cord contacting element, which extends into the gap between two cords and provides electrical connection to both cords, thereby electrically connecting the two cords.

14 Claims, 6 Drawing Sheets



(51) **Int. Cl.**
B66B 7/08 (2006.01)
H02G 11/00 (2006.01)

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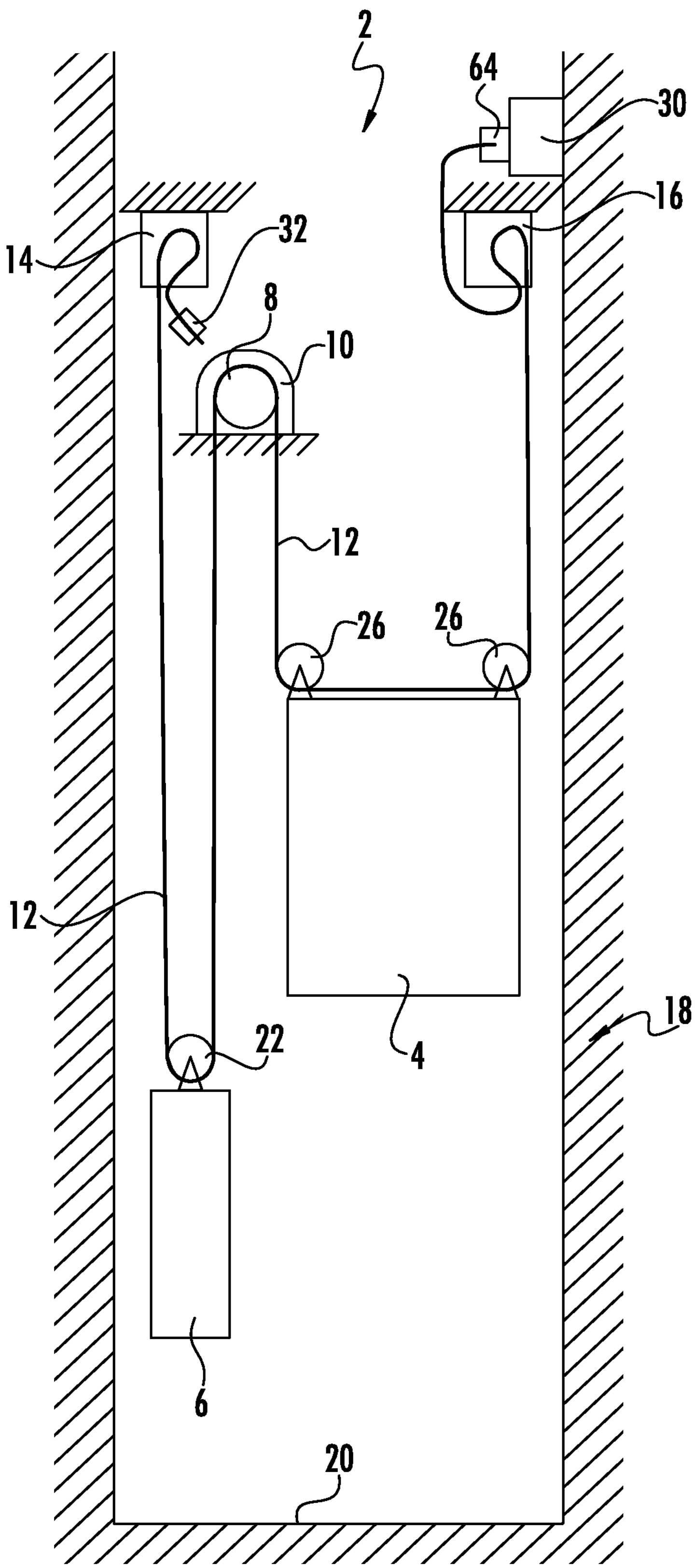

FIG. 1

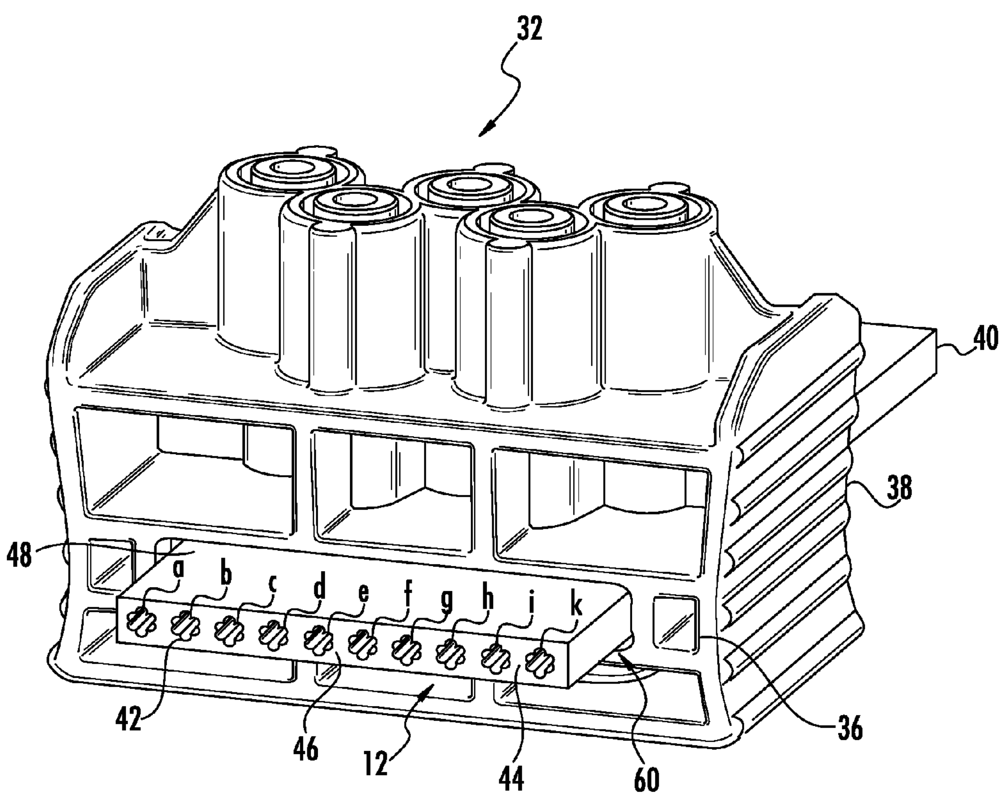

FIG. 2

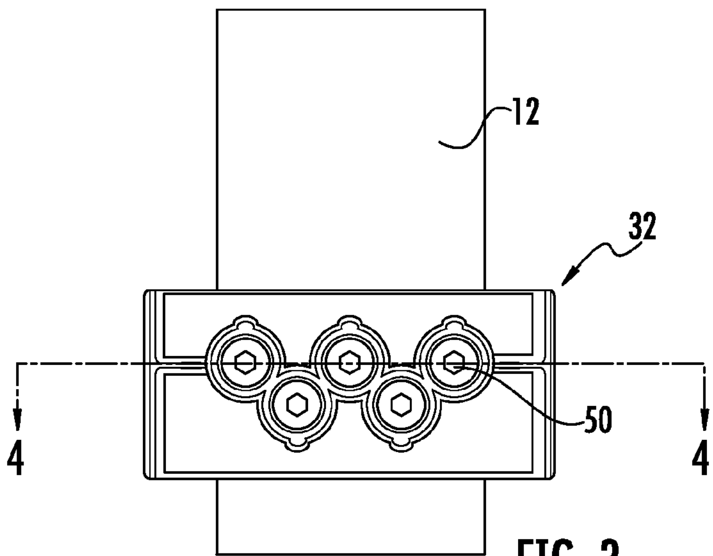

FIG. 3

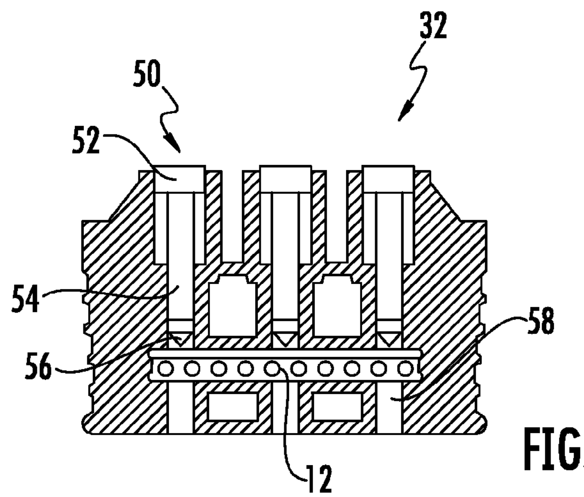

FIG. 4

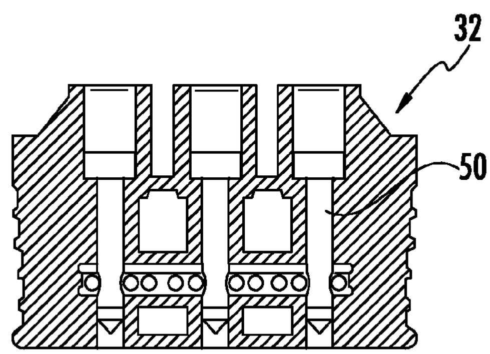

FIG. 5

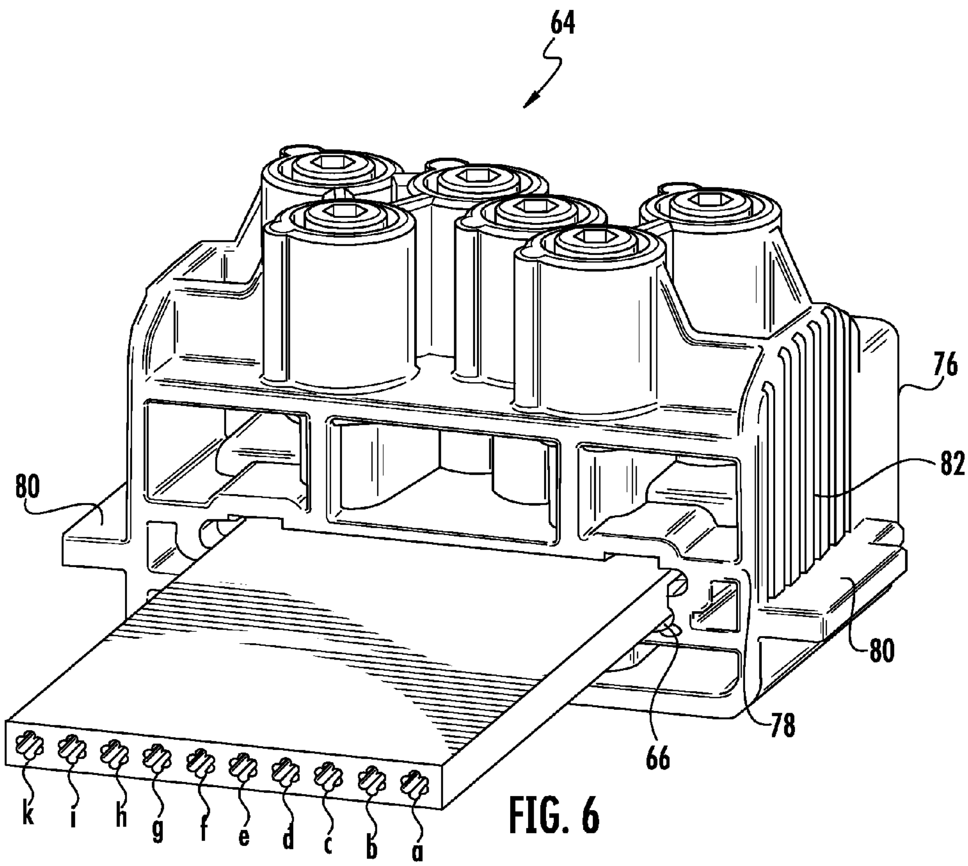

FIG. 6

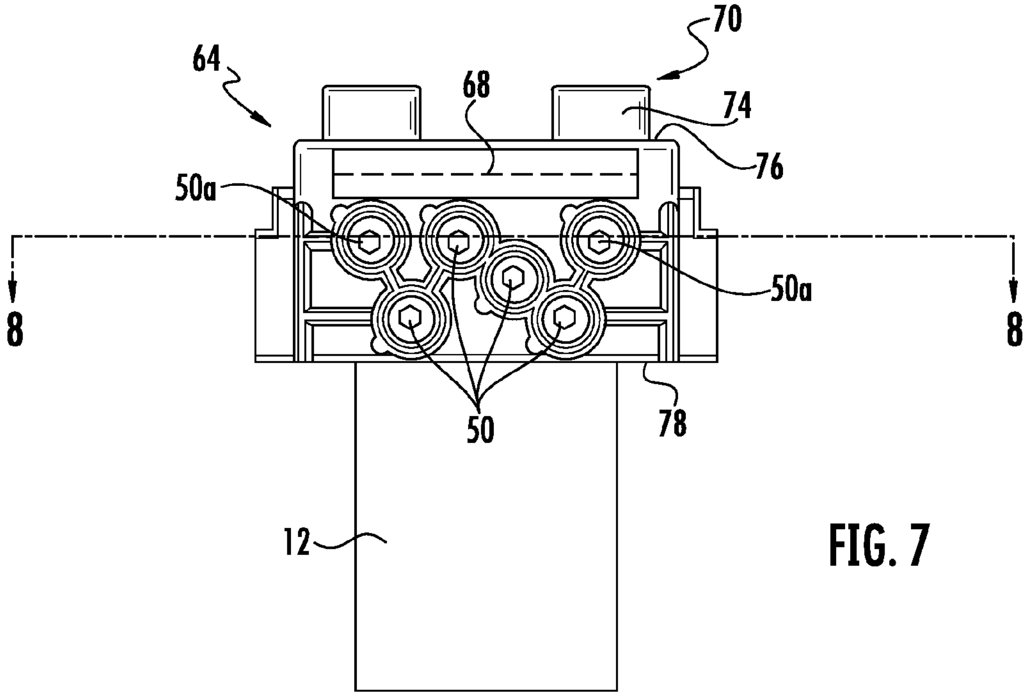

FIG. 7

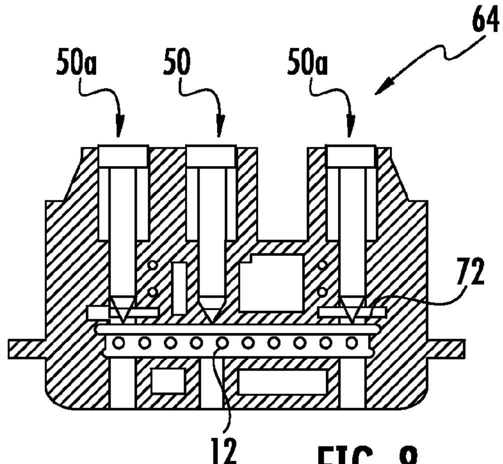

FIG. 8

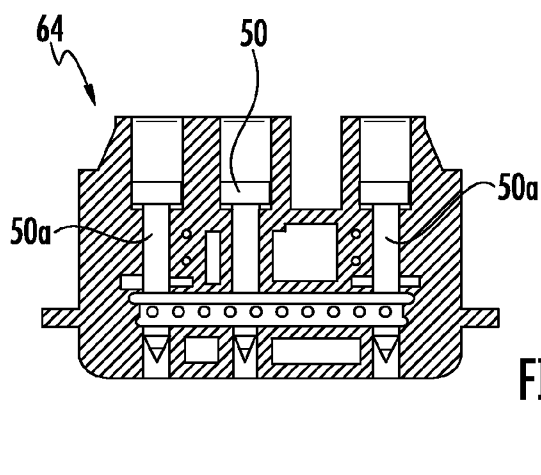

FIG. 9

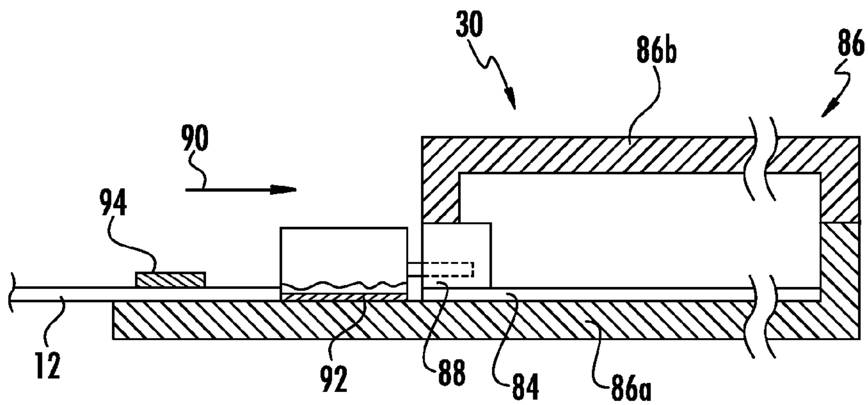

FIG. 10

ELEVATOR SYSTEM BELT HAVING CONNECTING DEVICES ATTACHED THERETO

The invention relates to an assembly comprising a belt, configured for use in an elevator system as a suspension belt for a car and a counterweight, or configured for use in an elevator system as a drive belt for a car or for a counterweight, or configured for use in an elevator system as a combined suspension and drive belt for a car and a counterweight, and at least one connecting device attached to the belt.

Modern elevator systems are in many cases equipped with belts having wire cords incorporated therein in a coating (rather than uncoated round ropes made of wires), which suspend or drive or suspend and drive an elevator car and a counterweight. If the belt has a drive function, i.e. transmits the forces required to move car and counterweight up and down, the design of the elevator system is frequently such that the belt runs over a drive sheave.

During operation of an elevator system, the wires within a respective cord make slight movements relative to each other, in particular where the belt runs over a sheave or over a deflection roller, whereby it is bent and thereafter stretched again into a straight line configuration. Over long periods of operation time, the relative movements of the wires result in a type of wear that is designated as fretting. Furthermore, individual wires can break due to fatigue after long periods of operation time, especially when they are weakened by fretting.

The manufacturers of elevator systems install belts which have to meet strict specifications as to the maximum tensional force they can transmit without risk of failure. The cords have a rated ultimate tensile strength, and typically the allowed maximum load is specified as ultimate tensile strength divided by a safety factor of typically 12 or 16. Due to the high safety factor, the belts are far away from any risk of failure, even if a certain amount of fretting has taken place, or a certain percentage of the wires in the cords or even if one of the plurality of cords in the belt have ruptured after use of the belt for a considerable time. Nonetheless, belts suffering from more than a tolerable amount of fretting or having more than a permitted percentage ruptured wires in the cords should be replaced by new belts.

It is known to monitor belts in elevator systems for deterioration of mechanical strength, in particular resulting from fretting on the wires and/or broken wires. A common way of monitoring comprises transmitting an electrical signal (pulse or pulses; or current flowing for a longer period of time) through the cords and determining and analysing the transmitted signal. For example the amplitude or other changes of the transmitted signal as compared to the original signal or to a reference signal stored in a belt monitoring unit, is an indication of a change in the cords. As an example, the electrical resistance of the cords could be monitored for changes.

It is known to attach one or more connecting devices to the belt, the respective connecting device comprising cord contacting elements that provide an electrical connection between the respective contacting element and a cord in the belt. Based on such an electrical connection, it is for example possible to input or output electrical signals to or from the respective cord. Depending on the design of the connecting device and the way of monitoring the belt, it is further known to provide an external lead connection between two cord contacting elements, so that it is possible to short-circuit two cords.

Known assemblies of belt and connecting device comprise a connecting device which includes a first portion, a second

portion, and screws clamping the two portions together with a section of the belt therebetween (WO 2005/094248 A2, WO 2005/094249 A2). The cord contacting elements are pins with acute tips positioned at locations facing the central portion of the respective cords, when the belt section is properly placed in the connecting device. By turning the screws the two portions of the connecting device are moved to get closer to each other, whereby the actuate tips of the cord contacting elements pierce through the coating of the belt and into the centre portions (with respect to the widths) of the respective cords. Relatively high forces are required to urge the tips of all respective cord contacting elements into place all at the same time. Providing leads for connecting two cord contacting elements to short-circuit two cords, makes the connecting device complicated.

One subject-matter of the invention is an assembly comprising (a) a belt, which includes a plurality of wire cords extending lengthwise of the belt with spaces therebetween, and includes a coating of the cords extending into the spaces between the cords, said belt being configured for use in an elevator system as a suspension belt for a car and a counterweight, or being configured for use in an elevator system as a drive belt for a car or for a counterweight, or being configured for use in an elevator system as a combined suspension and drive belt for a car and a counterweight;

(b) a first connecting device including a first number of cord contacting elements providing electrical connections contacting element-to-cord; and

(c) a second connecting device, including a second number of cord contacting elements providing electrical connections contacting element-to-cord, and including at least two conductive elements, each being electrically connected to a respective one of the cord contacting elements, the conductive elements being provided for making electrical connections to a belt monitoring unit which monitors the proper condition of the cords on the basis of electrical signals passed through the cords;

(d) wherein at least one of the first and second connecting devices includes at least one bridge type cord contacting element, which extends into the gap between two cords and provides electrical connection to both cords, thereby electrically connecting the two cords.

Another subject-matter of the invention is a method of mounting a connecting device to a belt, which includes a plurality of wire cords extending lengthwise of the belt with spaces therebetween and includes a coating of the cords extending into the spaces between the cords, said belt being configured for use in an elevator system as a suspension belt for a car and a counterweight, or being configured for use in an elevator system as a drive belt for a car or for a counterweight, or being configured for use in an elevator system as a combined suspension and drive belt for a car and a counterweight;

wherein said connecting device includes a slot that either extends as an open passage through the connecting device, or has, in one end portion thereof, a stop portion for the belt associated to the slot;

and wherein said connecting device includes at least one bore and one screw engaging a wall of the bore, the bore having an axis that traverses the slot;

said method comprising placing a section of said belt in said slot and turning said at least one screw, whereby a portion of the screw is urged into one of the spaces between two cords into contact with the two cords, thereby providing an electrical connection between the two cords.

The invention provides a connecting device, designed for use attached to the belt of an elevator system, which can be mounted to the belt more readily than the above-described prior art connecting devices.

The invention further provides a connecting device, designed for use attached to the belt of an elevator system, which produces in a simple way a well-defined electrical connection between the respective cord contacting element and a cord.

The invention further provides a connecting device, designed for use attached to the belt of an elevator system, which facilitates establishing a short-circuit connection between two cords in the belts.

The invention will be further elucidated by means of non-limiting embodiments and by means of drawings showing those embodiments.

FIG. **1** is an elevation view and illustrates schematically an elevator system in an elevator shaft;

FIG. **2** is a perspective view and illustrates a connecting device of a type designated "first connecting device" in the present application;

FIG. **3** is a plan view of the connecting device shown in FIG. **2**;

FIG. **4** is a sectional view, taken along the line IV-IV in FIG. **3**;

FIG. **5** is a sectional view taken along the line IV-IV in FIG. **3**, and illustrates a situation where cord contacting elements have been brought into in-use positions;

FIG. **6** is a perspective view and illustrates a connecting device of a type designated "second connecting device" in the present application;

FIG. **7** is a plan view of the connecting device shown in FIG. **6**;

FIG. **8** is a sectional view, taken along the line VIII-VIII in FIG. **7**;

FIG. **9** is a sectional view taken along the line VIII-VIII in FIG. **7**, and illustrates a situation where cord contacting elements have been brought into in-use positions;

FIG. **10** is an elevation view and illustrates schematically a situation where the second connecting device of FIGS. **6** to **9** has been assembled with a belt monitoring unit.

FIG. **1** shows the following mechanical main components of an elevator system **2**: passenger car **4**, counterweight **6**, drive sheave **8** driven by an electric drive motor **10** (located behind the plane of the drawing), and one belt **12** of a plurality of belts (typically two or three or four belts) which are located in a parallel relationship one behind the other (with some distance therebetween) when progressing in a direction perpendicular to the drawing plane. In a first end section of the respective belt **12**, the belt **12** is fixed to a first termination device **14**. In a second end section the respective belt **12** is fixed to a second termination device **16**. In one embodiment, the termination devices **14** and **16** are of a wedge clamp construction as it is known in the art.

A further mechanical component of the elevator system **2** or a first pair of guide rails for the passenger car **4**, and a second pair of guide rails for the counterweight **6**, as it is well-known in the art. In order not to decrease the clarity of FIG. **1**, those guide rails are not shown in FIG. **1**. The entire elevator system **2** is positioned within an elevator shaft **18** which typically has a rectangular, horizontal cross-section and is located within a building. In one embodiment, the not-shown guide rails rest, with their lower ends, on a floor **20** of the pit of the elevator shaft **18** and each are connected with clamps (not shown), mutually spaced, to the respective walls of the elevator shaft **18**, in order to prevent the guide rails from buckling. The electric motor **10** with, for example, the drive sheaves **8** mounted on the motor shaft or being formed by the motor shaft, rests directly or indirectly on one or a plurality of the guide rails. In another embodiment, the motor **10** is mounted to at least one wall or to a ceiling of the elevator shaft **18**. What has just been stated with respect to the mounting of the motor **10**, equally applies to the mounting of the termination devices **14** and **16**. It is stressed that, in further embodiments, the elevator system **2** is not positioned in a surrounding elevator shaft **18**, but of the panorama elevator type, and/or the elevator system **2** is an elevator system for load transportation, rather than for passenger transportation.

The belt **12** shown in FIG. **1** leads down from the first termination device **14** to a deflection roller **22** mounted to the counterweight **6**, then leads up to the respective drive sheave **8**, then leads down a first deflection roller **24** mounted to the passenger car **4**, then leads horizontally to a second deflection roller **26** mounted to the passenger car **4**, and finally leads up to the second termination device **16**. The same applies to the second (if provided) and third (if provided) and the fourth (if provided) etc. belt **12**, each belt **12** having "its own" first termination device **14**, deflection roller **22**, drive sheave **8**, deflection roller **24**, deflection roller **26**, and second termination device **16**. It is stressed, however, that there are other embodiments where a unitary rotating element serves the same function as multiple adjacent drive sheaves, for example in the way that a portion of the shaft of the motor **10** forms two or three or four drive sheave portions one next to the other with a suitable distance therebetween.

FIG. **1** further shows a belt monitoring unit **30**, mounted directly or indirectly to a wall of the elevator shaft **18** or to one or more guide rails. Furthermore, FIG. **1** shows a connecting device **32** of the type "first connecting device" and a further connecting device **64** of the type "second connecting device". Both connecting devices **32** and **64** are attached to the belt **12** in those portions of the respective belt end section, which are rearward from the respective termination device **14** or **16**, i.e. those portions which are not under the tensional force for suspending the passenger car **4** and the counterweight **6**.

The described type of suspending the car **4** and the counterweight **6** is known in the art and called 2.1 suspension. It is stressed that the invention may be practised in combination with all known types of suspension.

FIGS. **2** to **5** show the first connecting device **32** as attached to a portion of the belt **12**. The belt **12** either ends at a distance from that front end **36** of the first connecting device **32**, which faces the viewer to FIG. **2**, or ends within the first connecting device **32** between said front end **36** and the screws **50** to be described below. The belt **12** comes out from the opposite back end **38** of the first connecting device **32** and is then cut at **40** for the purpose of preparing the drawing of FIG. **2**. FIG. **1** shows that, in reality, the belt **12** continues into the first termination device **14** and thereafter for its further path as described hereinbefore.

In the illustrated embodiment, the belt includes ten cords **42**, designated with the letters a, b, c, d, e, f, g, h, i, k. Each cord **42** includes a central strand and six strands twisted around the centre strand. Each strand consists of a centre wire and six wires twisted around the centre wire. The wires are drawn wires made of high strength steel. Typical dimensions are 1.5 to 3.5 mm cord diameter and 0.12 to 0.4 mm wire diameter in the shown embodiment. Each time between two adjacent cords **42**, there are gaps **44** of a size somewhat smaller than the cord diameter. In alternative embodiments, the gaps **44** are larger than the cord diameter or have a width equal to the cord diameter. The cords **42** are embedded in a coating material **46**, typically synthetic rubber or polyurethane, which also fills the gaps **44** between cords **42**. What has been stated in the present paragraph referred to the illustrated embodiment. Other embodiments of the invention have cords of other designs and/or other sizes of its components and/or other materials and/or a different number of cords **42**. Typically, the belt **12** has an ultimate tensile strength in the range of 30 to 100 kN. In a further embodiment of the invention, the belt **12** does not have two planar surfaces (an upper planar surface **48** may be seen in FIG. **2**), but a number of longitudinal ribs provided in parallel at one of those surfaces. In this case, the wall of the first connecting device **32**, which is in contact with the ribbed side of the belt **12**, is provided with longitudinally extending grooves to accommodate the ribs.

As best be seen in FIGS. **2** and **3**, the first connecting device **32** includes five cord contacting elements **50**, which are screws, each time with a screw head **52**, a shank **54**, and a conical tip **56**. Each screw **50** co-operates with a respective bore **58** in the first connecting device **32**, the bore comprising a first section (having a larger diameter than the second and third sections), a second section above the belt **12** (having a slightly smaller diameter than the screw **50**), and a third section below the belt **12** (having the same diameter as the second section). In the situation shown in FIG. **4** (screws **50** partly screwed into the first connecting device **32**), a lower part of the shank **54** of the respective screw **50** is positioned in the second section of the bore **58**, whereas the remainder of the shank **54** and the major part of the screw head **52** are positioned in the first section of the bore **58**. Each bore **58**, including its first section having a larger diameter, extends through the first connecting device **32** from its upper side to its lower side (considering the orientation of the first connecting device **32** shown in FIG. **2**). A slot **60** extends horizontally (in the orientation shown in FIG. **2**) through the first connecting device **32** from its front end **36** to its back end **38**. The slot **60** has a shape and a size such that it accommodates the belt **12** with some, but not much clearance. In the present embodiment as illustrated in FIGS. **2** to **5**, the screws **50**, when screwed into the respective bore **58** from the initial position of FIG. **4** to the final position of FIG. **5**, each time act as short circuiting (making a direct electrical connection) between two adjacent cords **42**. As best seen in FIG. **4** in combination with FIGS. **2** and **3**, the screws **5** make direct electrical connections between the cords a and b, c and d, e and f, g and h, and i and k. Bringing each of the screws **50** into its lowermost, in-use position (shown in FIG. **5**) is an easy operation not requiring a big effort, because the acuate tip **56** of the screw is readily urged into the gap between the respective two adjacent cords **42**, the more so as each "short circuit bridge" is individually brought into its in-use position (shown in FIG. **5**), rather than all five cord contacting elements at the same time by turning two screws acting on a clamp type upper part of the connecting device.

The said first section of each bore **58** may serve to hold an end portion of a screw driver, used to turn the screws **50**, in place to avoid unintentional slipping out from the bore **58**.

Except for the screws **50**, the first connecting device **32** is a unitary element produced from plastics material by injection moulding. In the state after injection moulding, the bores **58** do not have female screw threads in their walls. Rather, each time the shank **54**, provided with male screw threads, of the respective screw **50** urges/deforms the plastics material into a female screw thread configuration, when screwed into the second section of the respective bore **58** from the beginning to the half-way down position shown in FIG. **4**.

Each time the shank **54** of the respective screw **50** has a diameter that is sufficiently larger than the gap between two adjacent cords **42**. This ensures that the shank **54** actually makes direct electrical contact to the two cords **42**. The tip portion **56** may have or may not have male screw threads. In the same way as it has been described for the second section of the respective bore **58**, each time the shank **54** of the respective screw **50** "screws itself" into the third section below the belt **12** of the respective bore **58**, cf. FIG. **5**. In this situation, the respective shank **54** with its male screw threads has been worked in-between the respective two cords **42**, thereby making sure that the coating material **46** has been removed there and perfect electrical contact is established. Thus, the five screws **50** are bridge type cord contacting elements. In the in-use end position shown in FIG. **5**, the lower surface of the respective screw head **52** rests against a shoulder **60** of the respective bore **58**.

FIGS. **2** and **3** show that the screws **50** and the bores **58** are not arranged in a straight line, but in an offset arrangement in two lines. This results in a very compact arrangement.

Reference is now made to the connecting device **64** illustrated in FIGS. **6** to **9**, which is of the type designated "second connecting device" in the present application. The differences of the second connecting device **64** as compared to the first connecting device **32** shall be described first:

A first difference is that the second connecting device **64** does not have an "open" slot extending from one end to the other end of the connecting device, as it has been the case with the slot **60** in the first connecting device **32**. Rather, there is a box-shaped deep recess **66** which ends at an end wall **68**, the inner face of which is shown by a phantom line in FIG. **7**. Apart from the end wall **68**, the recess **66** has a cross-sectional shape and size which are similar to the slot **60**. When the second connecting device **64** has been attached to the belt **12**, a final portion of the belt is positioned in the recess **66**, with the end face of the belt **12** abutting against the end wall **68**. The recess **66** accommodates the final portion of the belt **12** with a small clearance. The end wall **68** acts as a stop portion of the second connecting device **64**, and it is not required for its function that the stop portion closes the slot **60** completely. In an alternative embodiment, the slot **60** extends as an open passage completely through the second connecting device **64**, the same way as shown and described in connection with the first connecting device **32**.

As a second difference, the second connecting device **64** includes six bores **58** and six cord contacting elements in the form of screws. Four of those screws have been given the reference numeral **50** as in the first connecting device **32**. Those screws **50** have an analogous function as in the first connecting device **32**, i.e. they provide short-circuiting (make direct electrical connections) between the cords i and h, g and f, e and d, and c and b. Those screws **50** are screwed into the gaps between the respective two adjacent cords **42** in the same way as in the first connecting device **32** (but short-circuiting other "pairs" of cords **42**!). Thus, those four screws **50** are bridge type cord contacting elements.

As a third difference, the second connecting device **64** includes two screws **50***a*, which are positioned in the second connecting device **64** such that the axis of one screw **50***a* intersects substantially the centre line of the cord a (which is the cord closest to a first side edge of the belt **12**), and that the axis of the other screw **50***a* substantially intersects the centre line. of the cord k (which is the cord closest to the other side edge of the belt **12**). Thus, once these screws **50***a*, starting from the situation shown in FIG. **8**, are screwed deeper into the second connecting device **64**, each time they penetrate or pierce the cords a and k respectively. FIG. **9** shows the final, fully screwed-in position of the screws **50***a*, where a lower end portion of the respective shank **54** has been screwed into the third section of the respective bore **58** below the belt **12**. Thus, each screw **50***a* provides an electrical connection to only one of the cords a and k. The screws **50***a* have the same design as the previously described screws **50**, but due to their specific positions in the second connecting device **64** they have a function, as described, which is different from the function of the other screws **50**. In an alternative embodiment, at least one of the screws **50***a* has its axis offset from the centre line of the cord **42**, at a position between such centre line and the side of the cord **42** closer to the edge of the belt **12**.

As a fourth difference, the two screws **50***a* and one screw **50** are arranged in one line extending perpendicularly to the longitudinal direction of the belt **12**; two other screws **50** are arranged in a second line, extending parallel to the first described line in a certain distance; the fourth screw **50** is positioned halfway between those two lines.

As a fifth difference, the second connecting device **64** includes two conductive elements **70**, each having a first portion **72** accommodated in a respective recess, and a bifurcated second portion **74** protruding from a back end face **76** of the second connecting device **64**. The back end face **76** is opposite to the front end face **78** where the belt **12** has been inserted into the recess **66**. Each second portion **74** is surrounded by a protection wall **75** that has a rectangular configuration in cross-section.

Apart from the described differences, the second connecting device **64** is of a construction quite similar to the first connecting device **32**. It is worth mentioning though, that the second connecting device **64** is somewhat larger than the first connecting device **32** (measured in the longitudinal direction of the belt **12**) and that the second connecting device **64** has two protruding ribs **80**, one protruding from one side face and the other one protruding from the other side face **82** of the second connecting device **64**. Both ribs **80** lie in a common plane, which, in the present embodiment substantially coincides with the plane of the belt **12**.

Each screw **50***a* penetrates through a respective round opening in the first portion **72** of the respective conductive element **70**. In the state as manufactured, the respective opening has a smaller diameter than the shank **54** of the respective screw **50***a*. When the screw **50***a* is screwed, with part of its length, through the respective opening, a female screw thread is formed in the wall of the opening, whereby a perfect electrical connection between the conductive element **70** and the screw **50***a* is established. The conductive elements **70** are stamped out from plate-shaped metal.

As FIGS. **2** to **9** show, the axes of all bores **58** and of all screws **50** and **50***a* are perpendicular to the plane (to be understood as a plane laid through the belt **12** halfway between the upper surface and the lower surface thereof) of the belt **12**. In another embodiment, the angle is somewhat greater or smaller than 90°.

As best be seen in FIG. **1**, the "free" end section of the belt **12** (which exits from the second termination device **16** and is not under tensional load from the car **4** and the counterweight **6**) is long enough to extend to the belt monitoring unit **30**. The first-mentioned end section exiting from the second termination device **16** has its final end portion inserted into the second connecting device **64**, as shown in FIGS. **6** and **7**. After the screws **50** and **50***a* have been screwed into their in-use position, the second connecting device is plugged into the belt monitoring unit **30**. FIG. **10** illustrates that the belt monitoring unit **30** comprises a printed circuit board **84** and a housing **86** comprising a lower housing part **86***a* and an upper housing part **86***b*. In the housing **86** a connecting device **88** is provided which is fixed to the lower housing part **86***a* and/or the printed circuit board **84** and electrically connected to leads on the printed circuit board **84**. The second connecting unit **64** has been pushed in the direction of the arrow **90**, such that the

second portions **74** of the conductive elements **70** are inserted into female connectors in the connecting device **88**. The bottom wall of the second connecting device **64** comprises rectangular openings **92**, into which projections provided at the lower housing part **86***a* snap in, in order to provide for a preliminary fixation of the second connecting device **64** to the housing **86**. The final fixation of the second connecting device **64** to the belt monitoring unit **30** has thereafter been made by a bracket **94**, fixed to the lower housing part **86***a* by screws **96** positioned in front of and behind the drawing plane. The bracket **94** is located in close proximity to or even touching the second connecting device **64**. The bracket **94** presses on the belt and provides "strain relieve", i.e. tensional forces exerted to the end section of the belt **12** are not transmitted to the second connecting device **64**. The bracket **94** further has the function to directly hold the second connecting device **64** in place.

The ribs **80** shown in FIGS. **6** to **9** of the second connecting device **64** each are positioned in a corresponding groove provided at the lower housing part **86***b*. In an alternative embodiment, the lower face and/or the upper face of each rib engages a rib provided at the lower housing part **86***b*. Thus, the ribs **80** serve to ensure a proper positioning of the second connecting device **64** on the lower housing part **86***b* and serve as a (further) instrument to prevent unintentional movement of the second connecting device **64** in the counter-direction of arrow **90**.

The belt monitoring unit **30** is connected to a voltage source and comprises the circuitry, from which electrical signals are fed into one of the conductive elements **70**. As it is evident from the drawings and the description hereinbefore, all the cords a through k are connected in a single series connection. The response to the signals fed into one of the conductive elements **70** is outputted from the other conductive element **70** into the circuitry on the printed circuit board **84**. The response signals are evaluated. A distinction of significance to the inputted signal or a distinction of significance to a model response signal stored in the belt monitoring unit **30**, shows that there was some degree of wear at at least one location of the entirety of cords **42**. The belt monitoring unit **30** may comprise circuitry and/or software to distinguish between a tolerable degree of wear and not-tolerable degree of wear.

In an alternative embodiment, each of the second portions **74** is configured as a female connector and each connector device **88** is configured as a male connector.

In the embodiment described hereinbefore, all the ten cords **42** are connected in one single series connection. Other embodiments are possible, for example providing a first group of cords a, b, c, d, which are connected in a first series connection, and a second group of cords e, f, g, h, i, k, which are connected in a second series connection. Four non-bridge type screws **50***a* and four conductive elements would be provided. The belt monitoring unit **30** would be designed to monitor each of the two series connections for wear of the cords **42** therein. In another embodiment, the number of cords **42** and the number of cord contacting elements are greater or smaller than in the illustrated embodiment.

In an alternative embodiment, the cord contacting elements **50**, **50***a* are not all positioned on one side of the belt **12** (as it was the case in FIGS. **2** to **9**), but part of them in a connecting device are positioned at one side of the belt **12**, whereas the remainder of them in the connecting device are positioned at the opposite side of the belt **12**. It is possible, especially in such an embodiment, to arrange the cord contacting elements all in one single row.

In an alternative embodiment, the bores **58** are designed differently from the drawings and the description given hereinbefore. One option is not to form female screw threads in the second and third sections of the respective bore **58**, but to design the bore arrangement as a template for inserting cord contacting elements at proper locations into the belt **12**. In this case, the cord contacting elements could be screws (this time not in threaded engagement with the wall of the bore **58**) screwed into the belt **12** or even nail-type elements pushed into the belt by a caliper-like instrument.

Belt monitoring units which input signals to cords in an elevator system belt and evaluate the response signals for wear of the belt, are known in the art, for example WO 2005/095252 A1 and WO 2005/094248 A2. Belt monitoring units of such design are suitable to be used in connection with the invention, and belt monitoring units of other design may also be used.

A further subject-matter of the invention is a connecting device per se as disclosed in the present application. The connecting device is configured to be attached to a belt (having cords embedded in a coating material) configured to be used in an elevator system. The connecting device comprises cord contacting elements, screws in one embodiment. Each of the cord contacting elements may be either positioned and designed as a bridge type cord contacting element, or positioned and designed as a non-bridge type cord contacting element which provides electrical connection to only one cord. In the embodiment referred to in this paragraph of the application, one or plural bridge type cord contacting element(s) is/are not an obligatory feature of the invention. This embodiment may comprise one or more other features disclosed in the present application. The embodiment may be such that individual cords, or individual cord pairs, or any multiple of cords, or any multiple of cord pairs are connected to the belt monitoring unit **30** and monitored either individually or in groups of more than one cord.

The invention claimed is:

1. An assembly comprising:

(a) a belt, which includes cords extending lengthwise of the belt with spaces therebetween, and includes a coating of the cords extending into spaces between the cords, said belt being configured for use in an elevator system as a suspension belt for a car and a counterweight, or being configured for use in the elevator system as a drive belt for the car or for the counterweight, or being configured for use in the elevator system as a combined suspension and drive belt for the car and the counterweight;

(b) a first connecting device including a first number of cord contacting elements providing electrical connections contacting element-to-cord; and

(c) a second connecting device, including a second number of cord contacting elements providing electrical connections contacting element-to-cord, and including at least two conductive elements, each conductive element being electrically connected to a respective one of the second cord contacting elements, the conductive elements being provided for making electrical connections to a belt monitoring unit which monitors the proper condition of the cords on the basis of electrical signals passed through the cords;

(d) wherein at least one of the first and second connecting devices includes at least one bridge type cord contacting element, which extends into a gap between two cords of the cords and provides physical and electrical connection to both of the two cords, thereby electrically connecting the two cords.

2. The assembly of claim **1**,

wherein said at least one bridge type cord contacting element is a screw having a shank portion engaging a wall of a bore in one of the first connecting device and second connecting device, and having an end portion where the cross-sectional area of the screw is gradually reduced.

3. The assembly of claim **2**,

wherein at least part of the end portion has a male screw thread.

4. The assembly of claim **2**,

wherein said wall of said bore has a female screw thread, formed by the screw turned for mounting the same to the connecting device.

5. The assembly of claim **2**,

wherein said bore has at least two sections with a gap therebetween, and wherein a section of said belt is located in said gap.

6. The assembly of claim **1**,

wherein at least one of said conductive elements is penetrated by a screw pin, providing electrical connection with only one cord.

7. The assembly of claim **6**,

wherein said screw pin has a shank portion engaging a wall of a bore in the connecting device, and has an end portion where the cross-sectional area of the screw pin is gradually reduced, wherein said screw pin is positioned in the connecting device such that it penetrates the respective cord substantially in a central portion of its width.

8. The assembly of claim **1**,

wherein both the first and second connecting devices each include plural bridge type cord contacting elements.

9. The assembly of claim **8**,

wherein a number of cords in the belt is 2n, a number of bridge type cord contacting elements in the first connecting device is n, a number of bridge type cord contacting elements in the second connecting device is n−1, and a number of conductive elements in the second connecting device is 2, wherein all the cords in the belt are connected in an electrical series connection and wherein said assembly is configured such that it is possible to make the electrical connections between the assembly and said belt monitoring unit via the second connecting device only.

10. The assembly of claim **1**,

wherein said assembly is electrically connected to said belt monitoring unit, which comprises a housing, a printed circuit board, and a connector electrically connected to the printed circuit board; and

wherein said second connecting device is electrically connected by plug in connection to said connector.

11. The assembly of claim **10**,

wherein a belt section adjacent to the second connecting device is fixed to said housing by means of a fixation bracket.

12. A method of mounting a connecting device to a belt, which includes cords extending lengthwise of the belt with spaces therebetween and includes a coating of the cords extending into the spaces between the cords, said belt being configured for use in an elevator system as a suspension belt for a car and a counterweight, or being configured for use in the elevator system as a drive belt for the car or for the counterweight, or being configured for use in the elevator system as a combined suspension and drive belt for the car and the counterweight;

wherein said connecting device includes a slot that either extends as an open passage through the connecting device, or has, in one end portion thereof, a stop portion for the belt associated to the slot; and wherein said connecting device includes a bore and a screw engaging a wall of the bore, the bore having an axis that traverses the slot;

said method comprising placing a section of said belt in said slot and turning said screw, whereby a portion of the screw is urged into one of the spaces between two cords of the cords and into physical contact with the two cords, thereby providing an electrical connection between the two cords.

13. The method of claim **12**,

wherein the connecting device includes a first connecting device having plural first screws, whereby portions of each of said first screws provide an electrical connection between a respective pair of cords;

and wherein the connecting device includes a second connecting device having plural first screws and two second screws, whereby portions of each of said first screws provide an electrical connection between a respective pair of cords and portions of each of said second screws provide an electrical connection between only one cord and the second screw.

14. The method of claim **13**,

wherein electrical connections are made between said second screws and a belt monitoring unit, thereby establishing a circuit which includes all the cords in an electrical series connection and a component of the belt monitoring unit.

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